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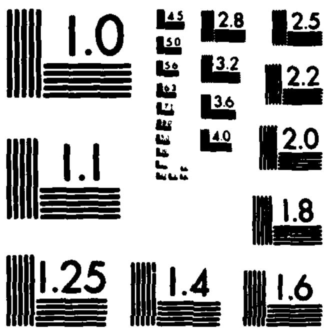
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dynamic ionosphere over Arecibo is simulated using a finite element technique. It is shown that the so-called 'collapse of the Arecibo F-Layer is caused by the upward-propagating semidiurnal tide excited in the upper stratosphere by ozone heating. The steep underside density gradients observed in conjunction with the collapse are shown to be due to the shear in themeridional wind field of the semidiurnal tide. These gradients are capable of triggering the gradient drift plasma instability,

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and accounting for plasma irregularity formation and observations of VHF scintillations associated with the collapse phenonmenon.

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Boston University

Department of Electrical, Computer, and Systems Engineering

Final Technical Report

1 June 1984 - 1 December 1984

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Dynamical - Chemical Coupling In The Mesosphere And Lower Thermosphere

Professor Jeffrey M. Forbes
Principal Investigator

1. INTRODUCTION

Due to the transfer of the Principal Investigator, Prof. Jeffrey M. Forbes, from Boston College to Boston University during January 1984, Grant AFOSR-81-0090 to Boston College was terminated and the remaining funds ($19,326 total) were re-awarded to the P.I. at Boston University to complete the work. This report constitutes the final report under the re-award grant AFOSR-84-0182 to Boston University.

2. FINITE-ELEMENT SIMULATION OF THE "MIDNIGHT COLLAPSE" OF THE IONOSPHERE OVER ARECIBO.

A numerical simulation code using the finite element technique developed and utilized by Prof. M. Mendillo and the Astronomy Department Group at Boston University for modelling F-region chemical releases with characteristic times of less than an hour was modified for the simulation of longer period phenomena with special emphasis on the dynamical behavior of the F-region ionosphere. Modifications for the study of F-region dynamical behavior included making provisions for (a) photoionization; (b) winds; (c) electric fields; (d) airglow calculations; and (e) protonospheric replenishment at night. All of these efforts required much debugging and testing against "known results" at many levels of development.

The main result of the simulations was that the dynamic behavior of the Arecibo ionosphere results directly from upward propagating semidiurnal tidal components of the neutral wind excited below thermospheric levels. The addition of terdiurnal and higher - order components in the wind field improves the agreement with experiment and it is hypothesized that these reslut from the non-linear coupling between the neutral wind and the diurnal variation in ion-drag. In addition, the steep underside density gradients occuring in conjunction with the collapse are shown to be due to the shear in the meridional wind field, which is expected to be associated with upward propagating components of the semidiurnal wind described above. These gradients are capable of triggering the gradient drift plasma instability, and accounting for plasma irregularity formation and observations of VHF scintillations associated with the collapse phenomenon.

Furthermore, we have shown the importance of an abatement, rather than reversal, of the neutral wind velocities in determining the level of h_{max} in our model. This is especially germane in the case of the pre-sunrise increase in h_{max} when an increase in the height of the peak occurs when vertical drifts due to neutral winds are large in magnitude and downward.

The above results are discussed in detail in the manuscript "The Dynamic Ionosphere over Arecibo: A Theoretical Investigation" by D.J. Crary and J.M. Forbes, J. Geophys. Res., to appear in late 1985 or early 1986.

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